Study of heavy charged Higgs in

$gb \rightarrow H^+\bar{t}; \quad H^+ \rightarrow \tau^+\nu, \quad \bar{t} \rightarrow \bar{b}q\bar{q}$

● **Production in PYTHIA through:** $g\bar{b} \rightarrow H^+\bar{t}$

Normalization of the cross section to the results from Moretti & Roy

for m_{H+}=400 GeV, $\tan\beta = 40$: $\quad \sigma \sim 1$ pb

● **BR($H^+ \rightarrow \tau\nu$) from HDECAY:**

m_{H+}=407 GeV, $\tan\beta = 30$ 14.1%

m_{H+}=214 GeV, $\tan\beta = 15$ 36.8%

● τ **decay with polarization**

implemented to PYTHIA according to D. P. Roy

● **Detector simulation with CMSJET**

Event selection for tH^+, $H^+ \to \tau\nu$, $\tau \to h^+ + X$

1) τ selection:

   jet, $E_t > 100$ GeV, $|\eta| < 2.5$ containing

   one track with $r = p^h / E^{jet} > 0.8$, $\Delta R(\text{jet,track}) < 0.1$

2) $E_t^{miss} > 100$ GeV

3) W and top mass reconstruction from jets with $E_t > 20$ GeV

   minimizing $\chi = (m_{jj} - m_W)^2 + (m_{jjj} - m_{top})^2$

4) W mass cut, $|m_{jj} - m_W| < 15$ GeV

5) top mass cut, $|m_{jjj} - m_{top}| < 20$ GeV

6) Tagging of the jet not assigned to W with $E_t > 30$ GeV, $|\eta| < 2.5$,

   efficiencies from TDR (≥ 2 tracks, $p_t > 1$, GeV, $\sigma^{ip} > 2$):

   50% for b-jets, 1.3 % for non-b-jets

7) Central jet veto, $E_t^{jet} > 40$ GeV
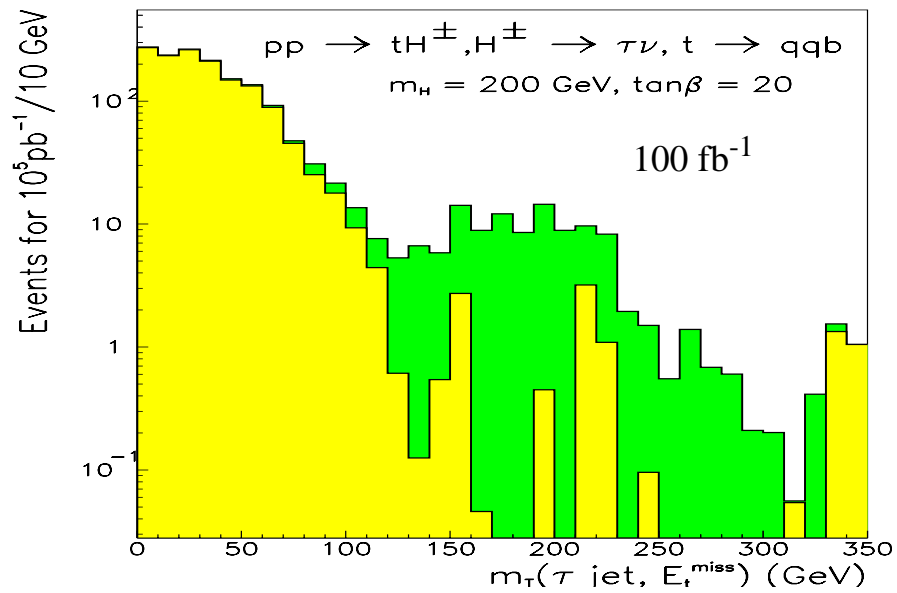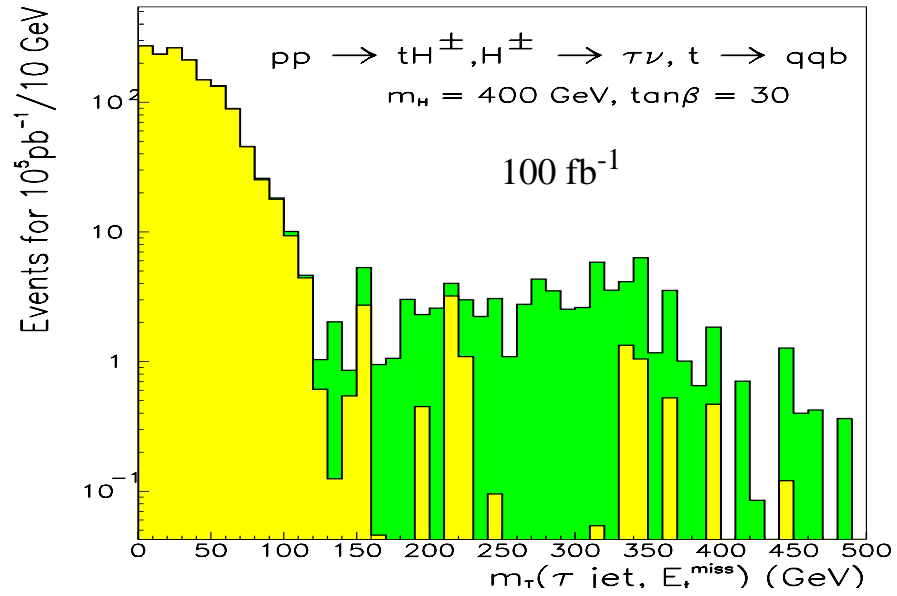
8) Second top veto, $|m_{\tau\nu j} - m_{top}| > 130$ GeV

9) Reconstruction of $m_T(\tau \text{ jet}, E_t^{miss})$ from τ jet and E_t^{miss}

$\mathbf{m_T(\tau\text{-jet},E_t^{miss})}$

with τ selection, top mass reconstruction and b-tagging

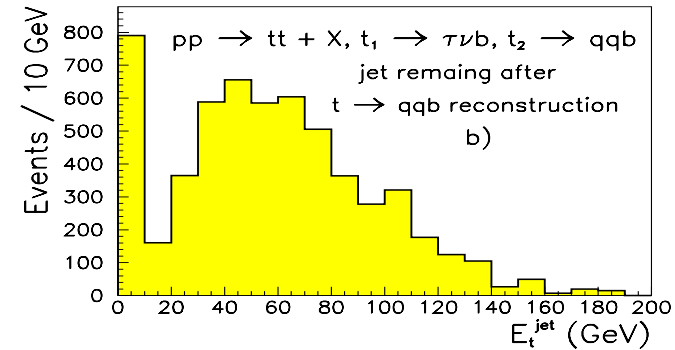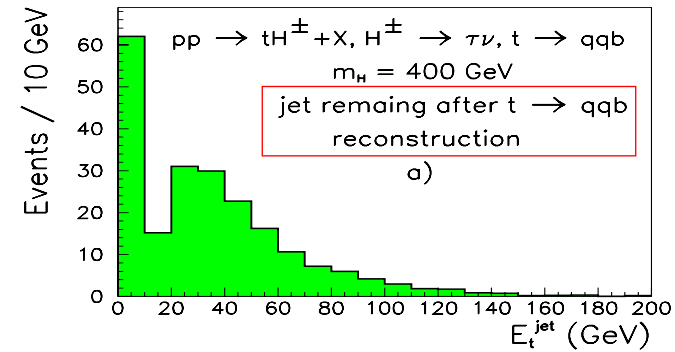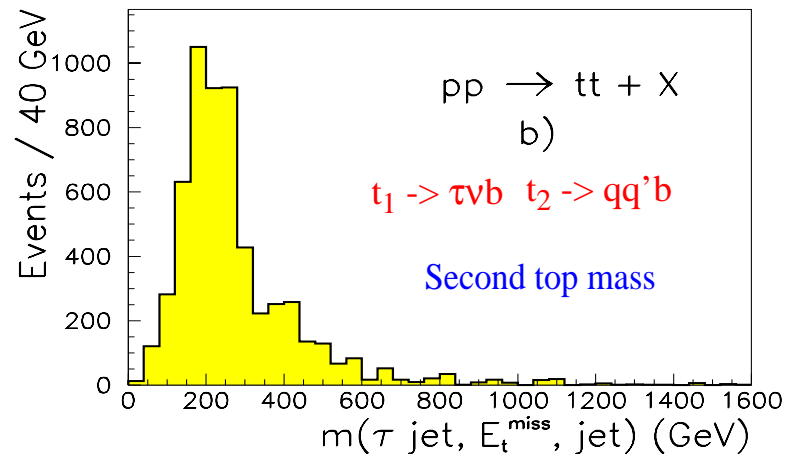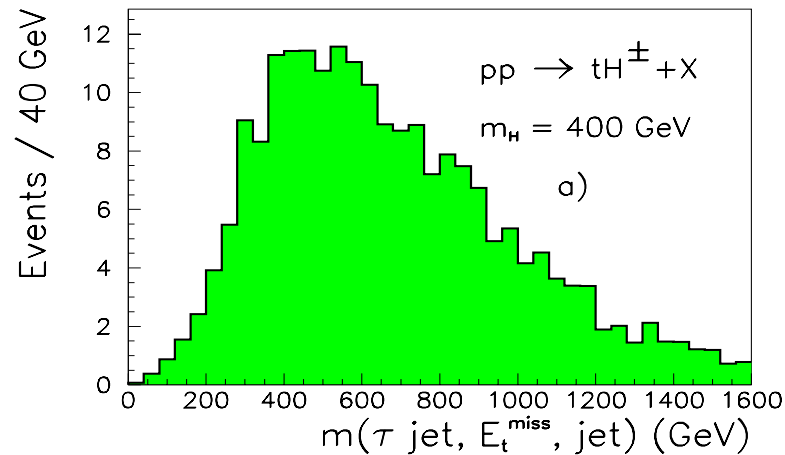Background from $t\bar{t}$, Wt and W+jet events

Jet veto and veto on a second top in t$\bar{t}$ events

Reconstruction of p_L^ν from W mass consraint (W ->$\tau\nu$)

Reconstruction of top mass from τ jet, ν and one remaining jet

Second top veto cut: m(τ–jet,ν.jet) > 300 GeV

Central jet veto: no jet with E_t > 40 GeV, $|\eta|$ < 2.5
(other than τ jet and jets from t -> qq'b)

pp $\longrightarrow$ tH$^\pm$+X

m_H = 400 GeV

a)

pp $\longrightarrow$ tt + X

b)

t_1 -> $\tau\nu$b t_2 -> qq'b

Second top mass

pp $\longrightarrow$ tH$^\pm$+X, H$^\pm$ $\longrightarrow$ $\tau\nu$, t $\longrightarrow$ qqb

m_H = 400 GeV

jet remaing after t $\longrightarrow$ qqb reconstruction

a)

pp $\longrightarrow$ tt + X, t_1 $\longrightarrow$ $\tau\nu$b, t_2 $\longrightarrow$ qqb

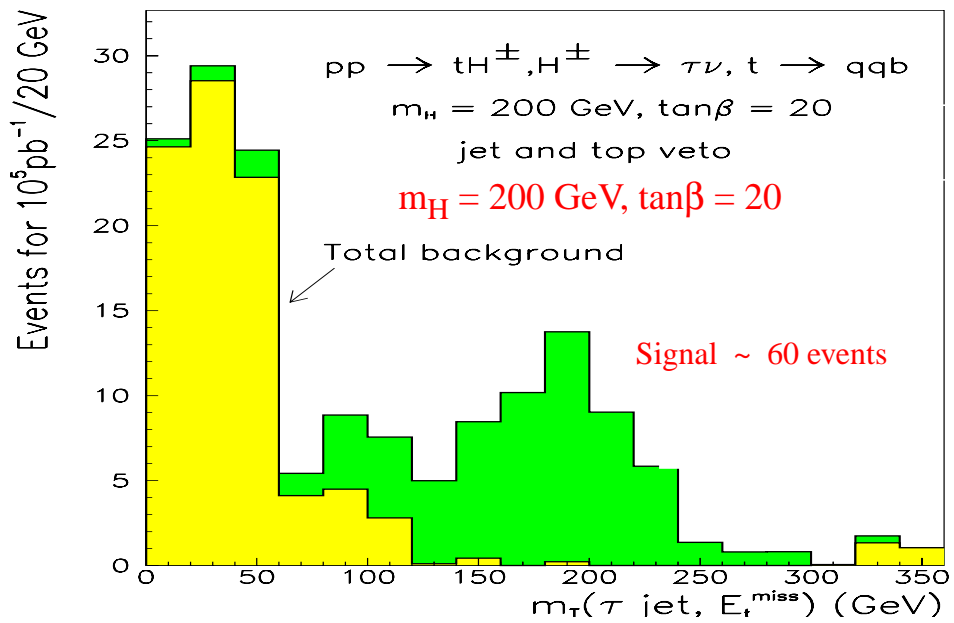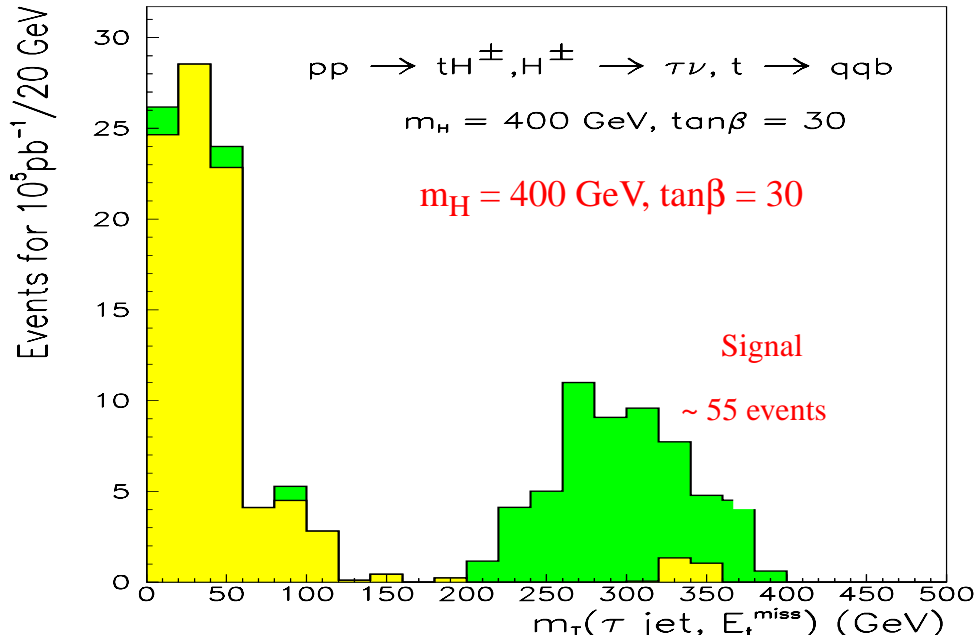jet remaing after t $\longrightarrow$ qqb reconstruction

b)

Combined jet and second top top veto:

Rejection factor agaist t$\bar{t}$ 15
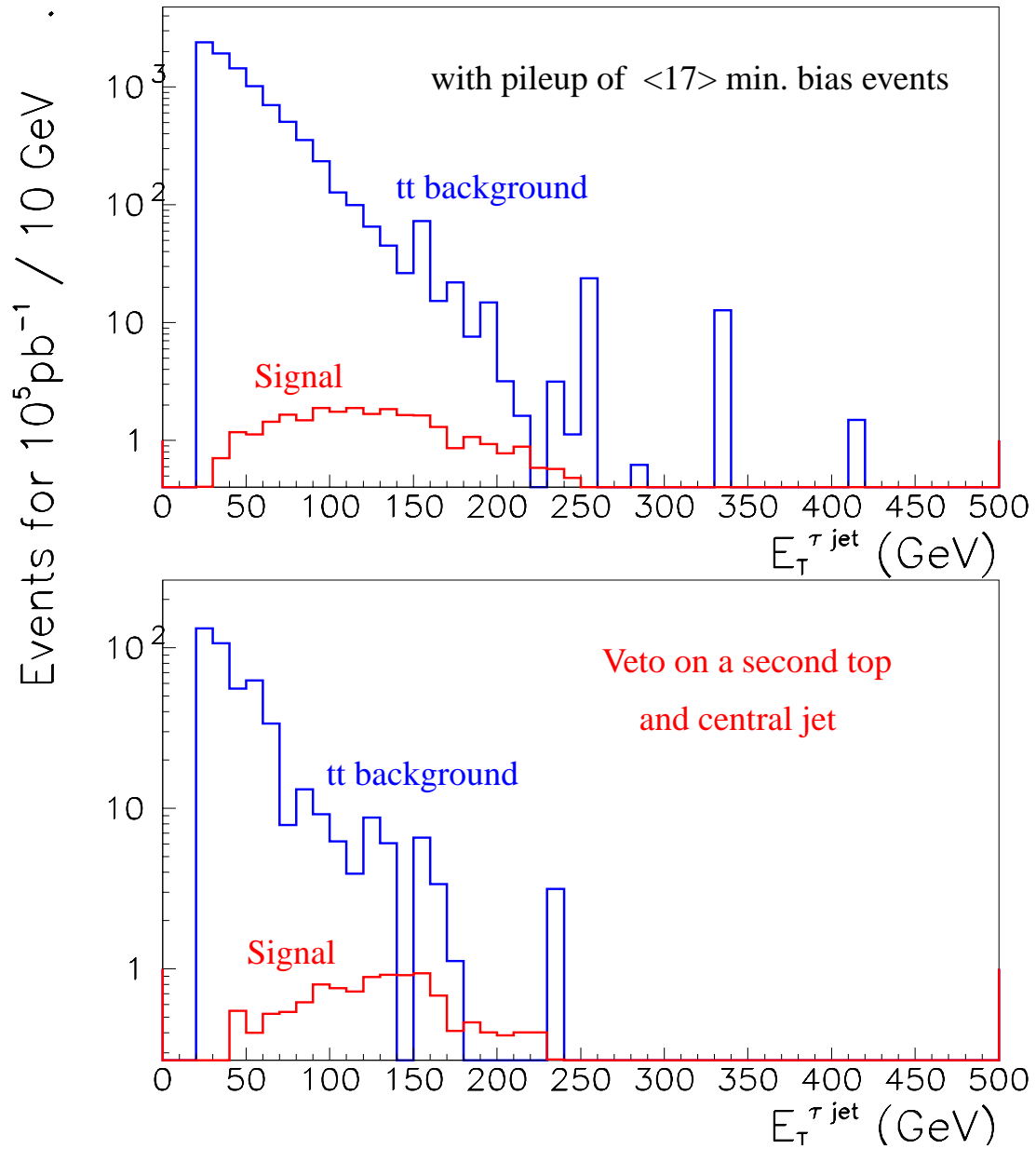
Efficiency for H$^+$ -> $\tau\nu$ ~ 50%

$m_T(\tau \, \text{jet}, E_t^{miss})$, $Lt = 100 \, \text{fb}^{-1}$

with veto on a central jet, $E_t^{jet} > 40 \, \text{GeV}$, $|\eta^{jet}| < 2.5$

and veto on a second top, $|m_{\tau\nu j} - m_{top}| > 130 \, \text{GeV}$

E_t of reconstructed τ jet for

tH^+, $H^+ \to \tau\nu$, $\tau \to \pi^+ + n\pi^0 + \nu$

$m_{H+} = 400$ GeV, $\tan\beta = 25$

with pileup of <17> min. bias events

tt background

Signal

$E_T^{\tau\,jet}$ (GeV)

Veto on a second top

and central jet

tt background

Signal

$E_T^{\tau\,jet}$ (GeV)

Events for $10^5 pb^{-1}$ / 10 GeV

τ selection: $p_t^h / E_t^{jet} > 0.8$, $E_t^{miss} > 100$ GeV

reconstruction of m_W and m_{top}, tagging of one b-jet